Agriculture Canada

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THE METRIC SYSTEM FOR FARMERS

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Sometime in the near future the metric system[a] will be adopted in Canada, but NOW is the time to start getting used to it. First adopted in France in the 18th century, the metric system has steadily gained acceptance as the international unit of measurement. Canada will be joining some 131 other countries already using this practical system of weights and measures.

The most obvious advantage of the metric system is its decimal nature; conversion to larger or smaller units involves only multiplication or division by multiples and submultiples of 10. In spite of this simplicity, it will take time and effort to change a lifetime habit of inches and pounds and begin thinking in metres and kilograms.

Converting measures from one system to another is always tedious and discouraging, in addition to being a source of errors and a waste of time. That is why it is important to start learning the metric language now, to familiarize yourself with the measures until you know them well. Once you realize that a metre is equal to about 39 inches, a hectare is about $2^1/_2$ acres and a kilogram a little over 2 pounds, you'll have made a good start.

This publication will pave the way. It has been prepared to make you think metric. Don't delay; start using it today!

THE METRE, KEY TO THE SYSTEM

In the metric system, all the measures of length, area, volume, capacity and weight are closely interrelated and they are all based on the metre.[b] A square with sides 1 metre long has a surface area of 1 square metre (1 m^2), an area slightly larger than 1 square yard. A cube with length, width and depth of 1 metre will be 1 cubic metre (1 m^3) in volume.

If such a cube is filled with pure water, the water will weigh 1 tonne.[c] This relationship between volume and weight was established when the metric system was set up and it was decided to make 1 tonne the weight of 1 cubic metre of water. Another liquid would not have the same weight, since each substance has its own density, or mass; that is, its weight in relation to volume. Cream for example, weighs less than water because of the fat it

contains. Thus, although the metre is the primary basis of the metric system, water is important, too, as it provides the link between volume and weight measurements.

LENGTH

The metre is the base unit of length. It is divided into smaller units called decimetres (tenths), centimetres (hundredths) and millimetres (thousandths). Deci means 1/10, centi means 1/100 and milli means 1/1000.

Larger units of length than the metre are called decametres, hectometres and kilometres. Deca means 10, hecto means 100 and kilo means 1000. Thus, a decametre equals 10 metres, a hectometre equals 100 metres and a kilometre equals 1000 metres.
The units hectometre, decametre and decimetre are very seldom used, but you should become familiar with the other four. Use them often.

[a] The original metric system has been refined a number of times. The latest version, called 'Système International' (S.I.), is the one officially adopted for Canada.

[b] The metre was originally intended to be equal to a 10-millionth part of the earth's meridional quadrant (that is, a quarter of the earth's north-south circumference divided by 10 million). This was first represented by a platinum-end standard, which was replaced in 1889 by the international prototype metre, a line standard of platinum-iridium. In 1960, the line standard was superseded by a more-accurate standard that is measured in light waves.

[c] 'Tonne' in the metric system is not to be confused with the British 'ton', which weighs 2,000 lb.

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CUSTOMARY MEASURES OF LENGTH AND APPROXIMATE METRIC EQUIVALENTS

10 miles				= 16.0 kilometres
9 miles				= 14.4 kilometres
8 miles				= 12.8 kilometres
7 miles				= 11.2 kilometres
6 miles				= 9.6 kilometres
5 miles				= 8.0 kilometres
4 miles				= 6.4 kilometres
3 miles				= 4.8 kilometres
2 miles				= 3.2 kilometres
1 mile	= 1760 yards	= 5 280 feet		= 1.6 kilometres
		10 feet		= 3.0 metres
	3 yards =	9 feet		= 2.7 metres
		8 feet		= 2.4 metres
		7 feet		= 2.1 metres
	2 yards =	6 feet		= 1.8 metres
		5 feet		= 1.5 metres
		4 feet		= 1.2 metres
	1 yard =	3 feet		= 0.9 metre
		2 feet		= 0.6 metre
		1 foot	= 12 inches	= 0.3 metre
			11 inches	= 27.94 centimetres
			10 inches	= 25.40 centimetres
			9 inches	= 22.86 centimetres
			8 inches	= 20.32 centimetres
			7 inches	= 17.78 centimetres
			6 inches	= 15.24 centimetres
			5 inches	= 12.70 centimetres
			4 inches	= 10.16 centimetres
			3 inches	= 7.62 centimetres
			2 inches	= 5.08 centimetres
			1 inch	= 2.54 centimetres
			3/4 inch	= 19.05 millimetres
			1/2 inch	= 12.70 millimetres
			1/4 inch	= 6.35 millimetres

To sum up:

1 kilometre (km) = 1000 metres
1 hectometre (hm) = 100 metres
1 decametre (dam) = 10 metres
1 metre (m)
1 decimetre (dm) = 1/10 of 1 metre, or 0.1 metre
1 centimetre (cm) = 1/100 of 1 metre, or 0.01 metre
1 millimetre (mm) = 1/1000 of 1 metre, or 0.001 metre

Here is a suggestion: on a corner of the barn or garage, paint a small red mark 50 cm from the ground, a slightly bigger mark at 1 metre, another small one at 1.50 m, a big one at 2 m and so on. Mark off similar points along the wall at ground level. Also, on the handle of a pitchfork, rake or hammer, mark off centimetres with a nylon-tipped pen and a ruler. Having these measurements constantly before your eyes will help you get

THE DARK & LIGHT COLORED AREA COMBINED IS ONE HECTA
THE SOLID COLORED AREA ALONE IS ONE ACRE

used to them. Before long, you'll find it easy to say at a glance that a pole is 6 metres high (almost 20 feet); or that a crop has grown 30 centimetres (about 1 foot) since you planted it.

AREA

For area, the derived unit is the square metre (m^2). Small areas are expressed in square centimetres. Very large areas are measured in square kilometres. A farmer's field is usually measured in hectares. "Hectare" is a special name for 10 000 square metres. These four units are the only ones you will need to know to express area measures metrically.

To sum up:

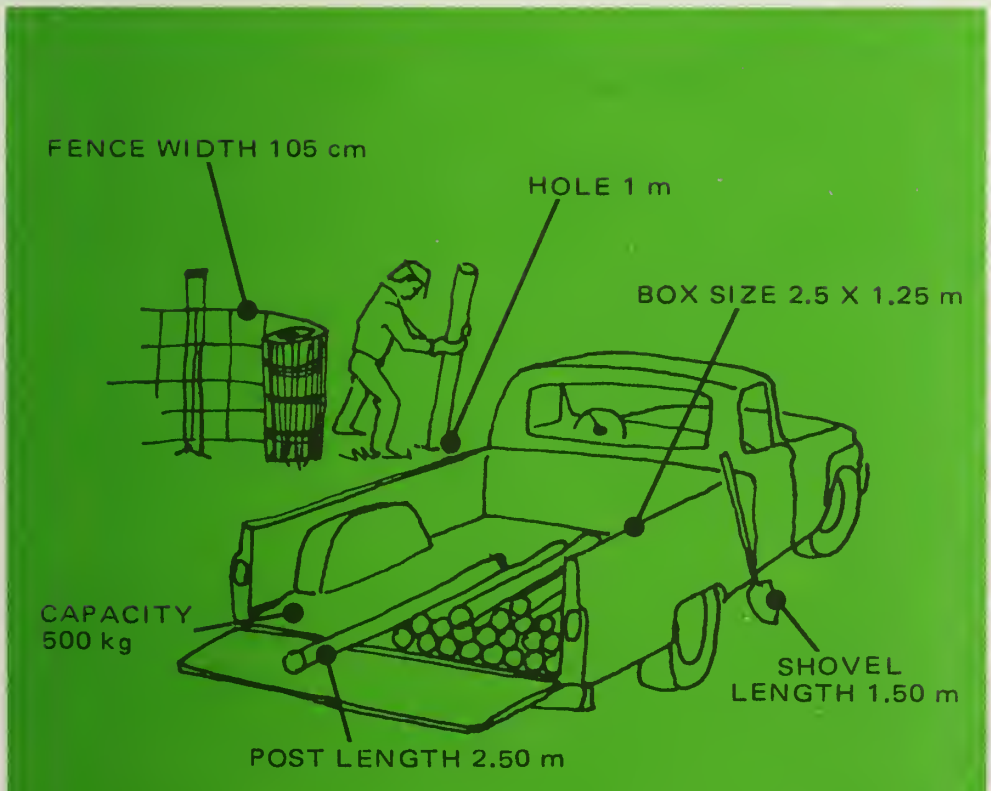
1 square kilometre (km^2) = 1 km X 1 km
1 hectare (ha) = 10 000 m^2 (100 m X 100 m)

1 square metre (m^2) = 1 m X 1 m
1 square centimetre (cm^2) = 1 cm X 1 cm

In the metric system, there is no surface unit corresponding to the 'section' used in Western Canada. Measurement is therefore in square kilometres (km^2) or hectares (ha). There are 100 hectares in a square kilometre. A section is 2.59 km^2 or about 259 ha.

Probably the best way for you to visualize a hectare, is to put red flags on the fence posts at the four corners of an area measuring 1 hectare. Each time you look at these flags you will become more familiar with the hectare. To mark off such an area, measure (in metres) the width of your land. If it measures 262 m, for example, then do the following calculation:

$$\frac{\text{1 hectare (in } m^2)}{\text{width of the land}} = \text{length in metres required to make 1 hectare}$$



Example:

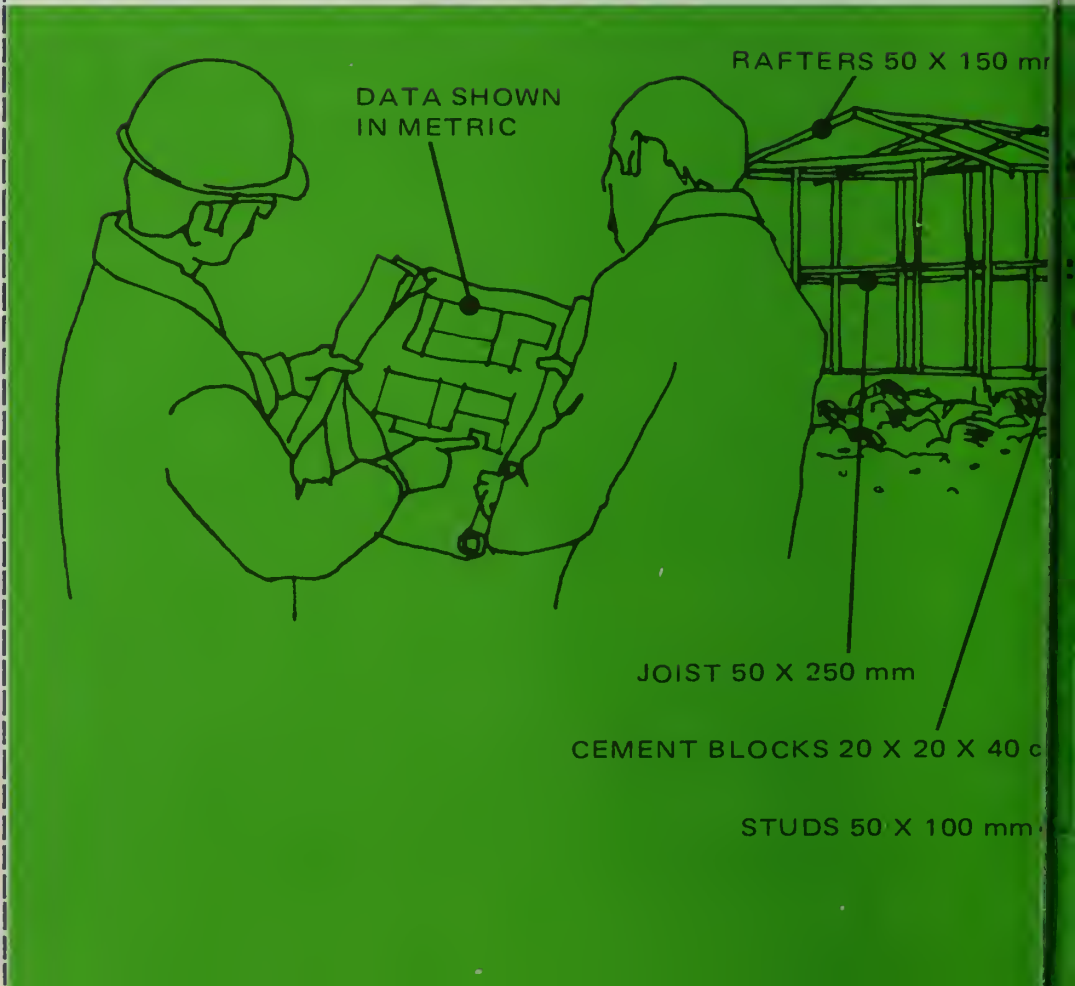
$$\frac{10\,000\ m^2}{262\ m} = 38\ m$$

You should also calculate the total surface area of your farm by converting acres to hectares. One acre = .404 ha; therefore, multiply the number of acres by .404.

Examples:

10 acres = 4.04 ha
50 acres = 20.20 ha
100 acres = 40.40 ha

A square metre, that is, a square with sides 1 m long, is about the size of a card-table surface. Your front yard might be 10m X 20 m or 200 m^2. Why not measure it so you'll know?



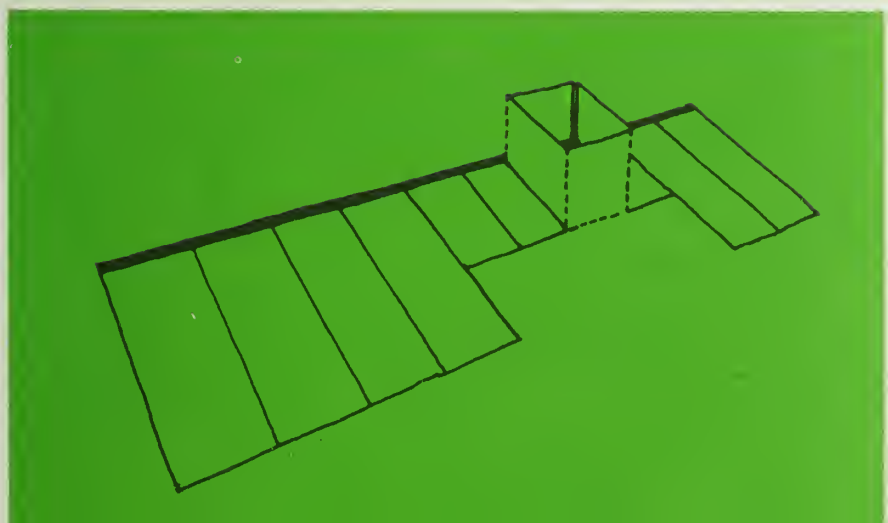
One square centimetre is a very small area – smaller than a dime. Some postage stamps are about 2 cm X 3 cm, or 6 cm^2 in area. For a more practical example, let's say you want to tile the floor of a vestibule 90 cm X 120 cm, or 10 800 cm^2 in area. The asphalt tiles you've selected are each 30 cm X 30 cm, or 900 cm^2 in area. Therefore, you'll need $\frac{10\,800}{900} = 12$ of these tiles to cover the floor.

VOLUME AND CAPACITY

The main unit of capacity or liquid volume is the litre, a special name for the cubic decimetre (dm^3). The most commonly used multiple of the litre is the kilolitre, or cubic metre (m^3); and the submultiple of the litre is the millilitre, or cubic centimetre (cm^3).

A litre is 1/1000 of a cubic metre; thus, there are 1000 litres in a cubic metre.

BY CUTTING ALONG THE SOLID LINE AND FOLDING ALONG THE DOTTED LINE A CUBE OF 1 dm^3 WHICH CONTAINS 1 LITRE MAY BE FORMED.



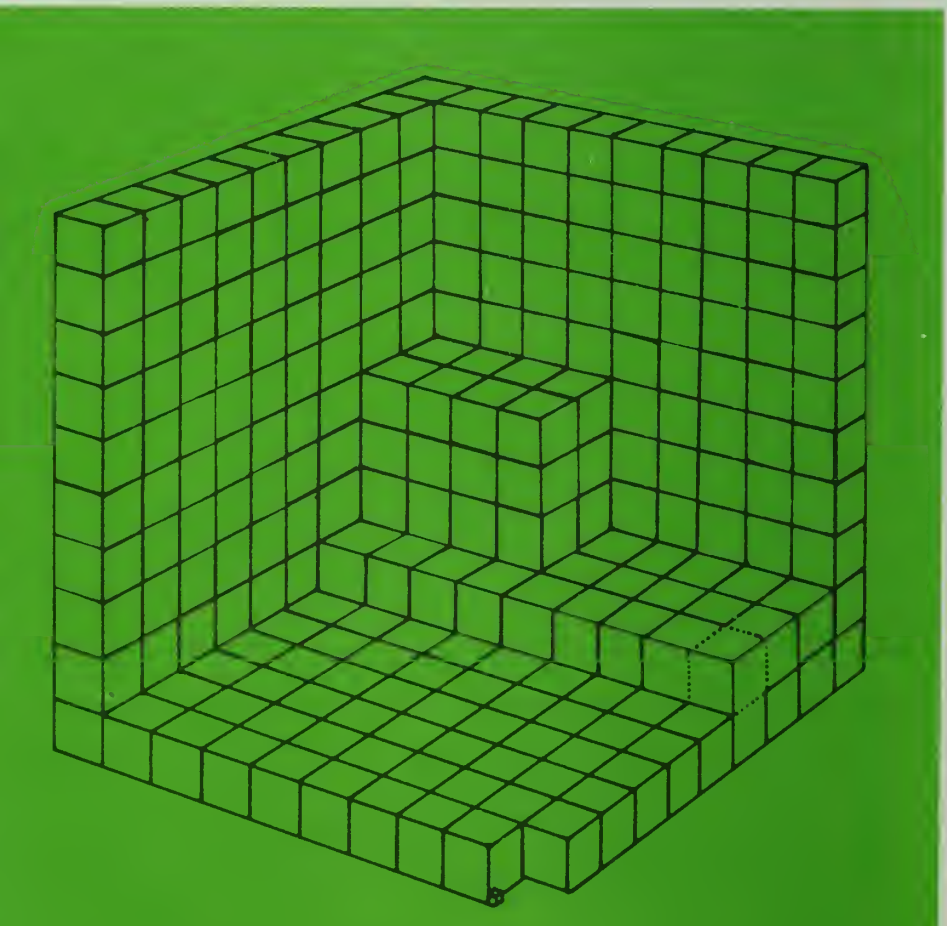
As mentioned earlier (see Length p. 3), there are 100 centimetres in a metre. Therefore, there are 100 X 100 X 100 = 1 000 000 cubic centimetres in a cubic metre. And, since this is equivalent to 1000 litres, there are $\frac{1\,000\,000}{1\,000}$ = 1000 cubic centimetres in a litre.

To sum up:

1 cubic metre (m^3) = 1 m X 1 m X 1 m
= 1000 litres
= 1 000 000 cubic centimetres

1 litre = 1/1000 of a cubic metre
= 1000 cubic centimetres

1 cubic centimetre (cm^3) = 1 cm X 1 cm X 1 cm
= 1/1000 of a litre
= 1/1 000 000 of a cubic metre



$1m^3$ IS MADE OF 1000 dm^3 AND CONTAINS 1000 LITRES OF LIQUID

There is a very close relationship between volume and weight in the metric system. This relationship is best shown by filling 1 cubic metre with pure water. Such a volume of water has been determined to weigh 1 metric tonne. Other liquids will have different weights because each substance has its own density, or mass per unit volume (the density of water is 1.0). For example, if you pour water into a jar containing oil, the water will settle at the bottom, indicating that water is heavier than oil. Since oil floats on top of water, it must have a lower density than water and therefore, 1 cubic metre of oil would weigh less than 1 tonne.

WEIGHT

The unit of weight is the gram (g). However, this is such a small measure that the kilogram (kg), which equals 1000 grams, is the main unit used. The tonne, equal to 1000 kilograms, is the largest measure of weight. All international trade in grain, for example, is in metric tonnes.

Earlier, when the relationship between volume and weight in the metric system was mentioned, it was explained that 1 cubic metre of pure water weighs 1 tonne (1000 kg). It follows, then, that 1 litre (1/1000 m^3) of water weighs 1 kilogram; and 1 centimetre (1/1000 litre) of water weighs 1/1000 kilogram, or 1 gram.

To sum up:

1 tonne = 1000 kilograms = the weight of 1 m^3 of pure water
1 kilogram (kg) = 1000 grams = the weight of 1 litre of pure water
1 gram (g) = the weight of 1 cm^3 of pure water

CROP YIELDS

Crop yields are expressed in kilograms or tonnes per hectare (or sometimes in litres per hectare). For example, an oat crop yield of 32 bushels per acre is approximately 1 220 kg per hectare, or 1.22 tonnes per hectare. This applies to oats only, as the same volume of another crop would have a different weight.

You can make the conversion from one system to another yourself if you know that:

For harvesting or seeding:

1 bushel per acre equals 89 litres (approximately) per hectare, whatever the kind of grain.

1 bushel of wheat, soybeans or potatoes per acre is the same as 67 kg per hectare.

1 bushel of rye, corn or linseed per acre is the same as 63 kg per hectare.

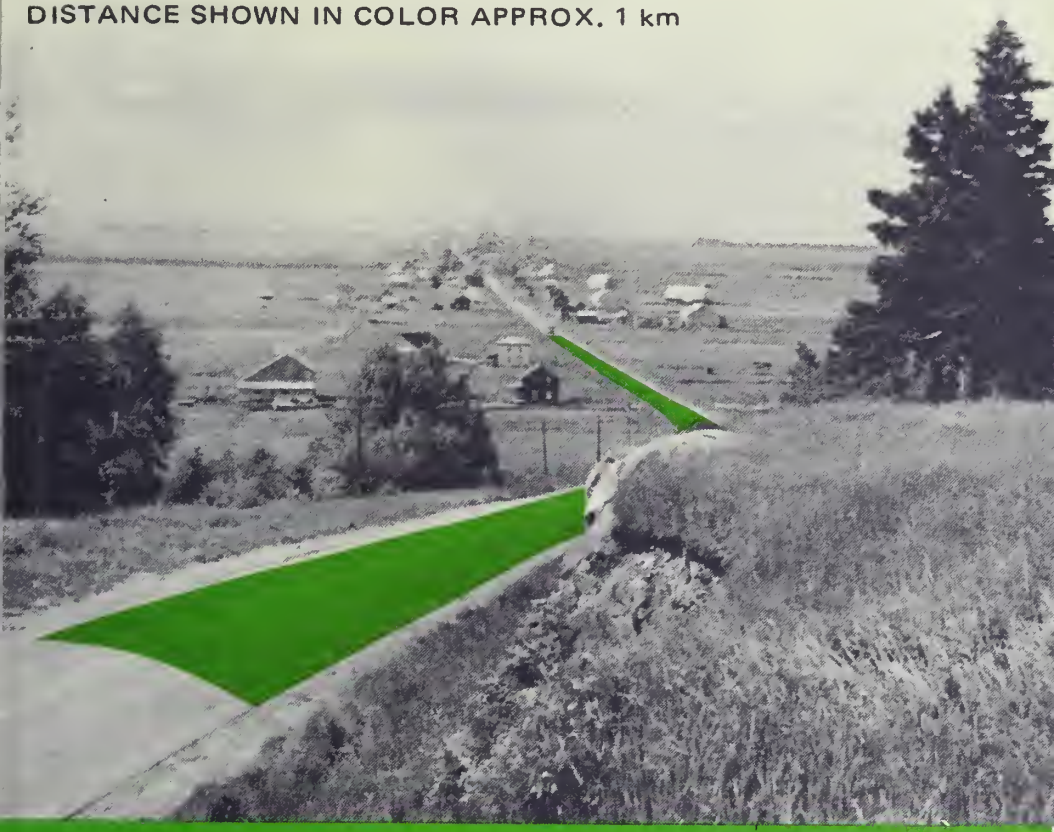
1 bushel of barley per acre is the same as 54 kg per hectare.

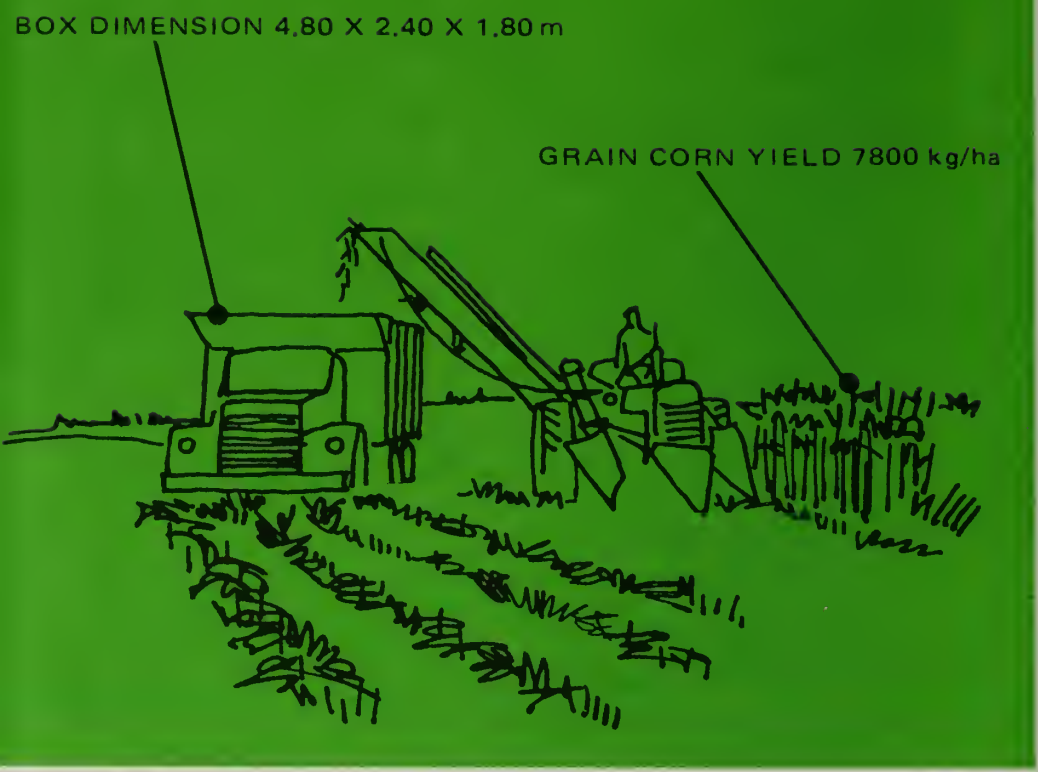
1 bushel of oats per acre is the same as 38 kg per hectare.

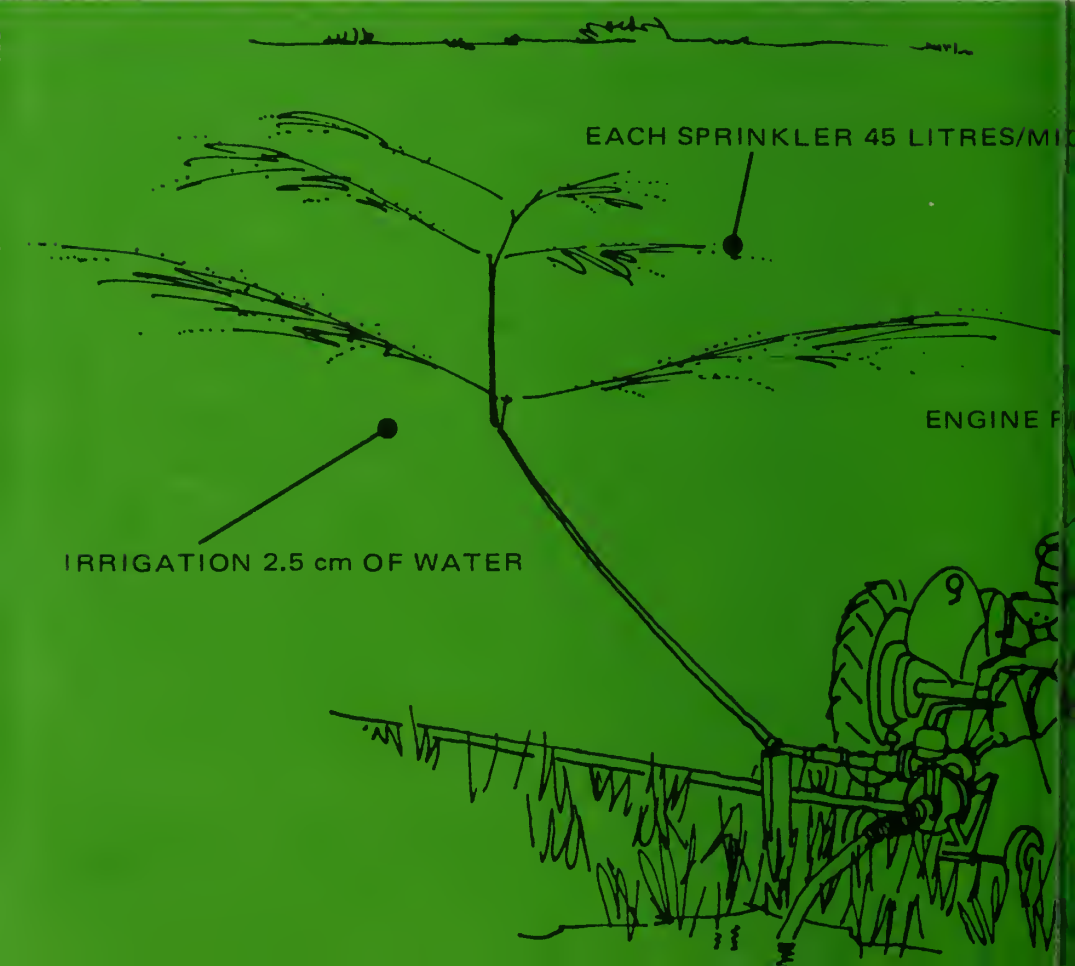
For fertilizers or pesticides:

1 pound per acre is the same as 1.1 kg per hectare.

DISTANCE SHOWN IN COLOR APPROX. 1 km




BOX DIMENSION 4,80 X 2,40 X 1,80 m
GRAIN CORN YIELD 7800 kg/ha


EACH SPRINKLER 45 LITRES/MI
ENGINE F
IRRIGATION 2.5 cm OF WATER

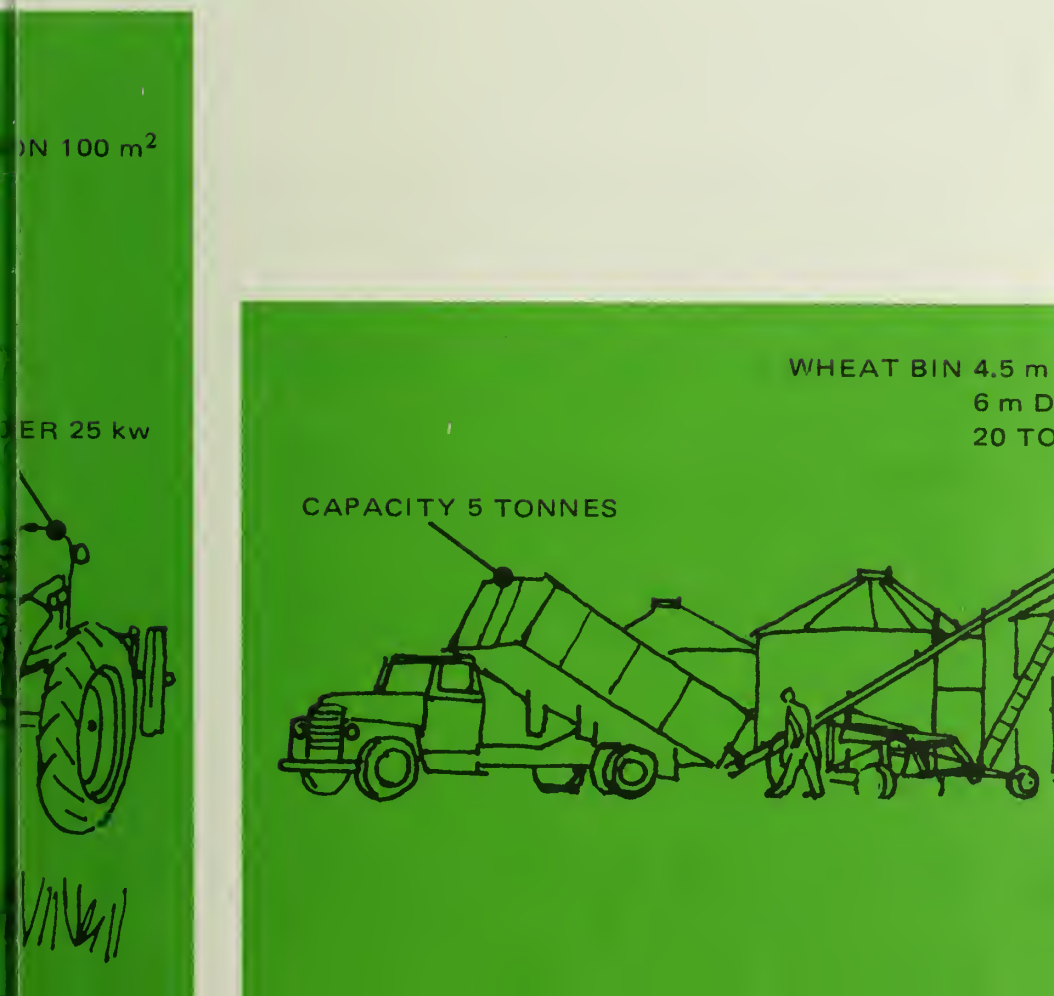
METRIC IN THE HOME

Many food, toiletries and home care products are already weighed or measured in both Canadian customary units of measurement and approximate metric unit equivalents. Soon all items purchased at the store or supermarket will be packaged or weighed in the metric system. To assist homemakers in becoming more familiar with the new system, the following conversion tables are given:

COMMON CANADIAN HOUSEHOLD MEASURES AND APPROXIMATE METRIC EQUIVALENTS

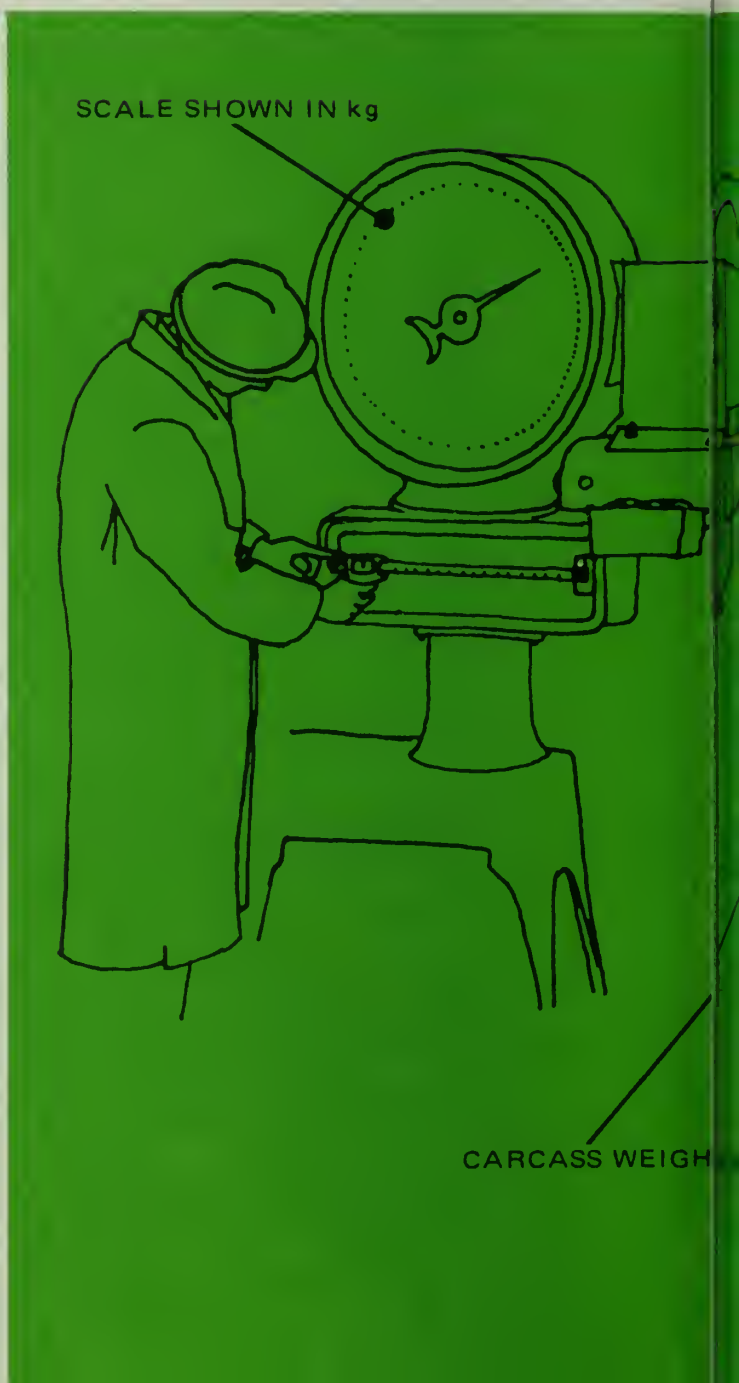
1 quart (40 fluid ounces)	= 1.14 litres
1 pint (20 fluid ounces)	= 568 millilitres
1 cup (8 U.S. fluid ounces)*	= 230 millilitres
1 tablespoon	= 15 millilitres
1 teaspoon	= 5 millilitres
1 fluid ounce	= 28 millilitres

*Most measuring cups are in U.S. fluid ounces.



COMMON OVEN TEMPERATURES

Fahrenheit		Celsius
250°F	very low	120°C
275°F	very low	135°C
300°F	low	150°C
325°F	moderately low	165°C
350°F	moderate	175°C
375°F	moderately hot	190°C
400°F	hot	205°C
425°F	hot	215°C
450°F	very hot	230°C



USEFUL THERMOMETER EQUIVALENTS

MEAT THERMOMETER		DEEP FRYING AND CANDY THERMOMETER	
Fahrenheit	Celsius	Fahrenheit	Celsius
165°F	74°C	212°F	100°C
170°F	77°C	218°F	103°C
175°F	79°C	250°F	121°C
180°F	82°C	310°F	154°C
185°F	85°C		
190°F	88°C		

0 kg

THIS FOLDER IS ONE M
WIDE, COVERS AN ARE
THICKNESS (10 PAGES)
TEXT WIDTH, 8 CENTIM
CENTIMETRES.

CUSTOMARY MEASURES OF WEIGHT, AVOIRDUPOIS, AND APPROXIMATE METRIC EQUIVALENTS

10 pounds	=	4.50 kilograms
9 pounds	=	4.05 kilograms
8 pounds	=	3.60 kilograms
7 pounds	=	3.15 kilograms
6 pounds	=	2.70 kilograms
5 pounds	=	2.25 kilograms
4 pounds	=	1.80 kilograms
3 pounds	=	1.35 kilograms
2 pounds	=	0.90 kilograms
1 pound = 16 ounces	=	0.45 kilograms
3/4 pound = 12 ounces	=	339 grams
1/2 pound = 8 ounces	=	226 grams
1/4 pound = 4 ounces	=	113 grams
1 ounce	=	28 grams

TER LONG, 20 CENTIMETRES
OF 0.20 m^2, HAS A FOLDED
OF 1 mm AND WEIGHS 20 GRAMS.
TRES WIDE, PAGE WIDTH 10

CUSTOMARY LIQUID MEASURES AND APPROXIMATE METRIC EQUIVALENTS

10 gallons	=	45.0 litres
9 gallons	=	40.5 litres
8 gallons	=	36.0 litres
7 gallons	=	31.5 litres
6 gallons	=	27.0 litres
5 gallons	=	22.5 litres
4 gallons	=	18.0 litres
3 gallons	=	13.5 litres
2 gallons	=	9.0 litres
1 gallon = 4 quarts	=	4.5 litres
3/4 gallon = 3 quarts	=	3.4 litres
1/2 gallon = 2 quarts	=	2.2 litres
1/4 gallon = 1 quart	=	1.1 litres

1 pint = 20 fluid ounces = 568.0 millilitres

1/2 pint = 10 fluid ounces = 284.0 millilitres

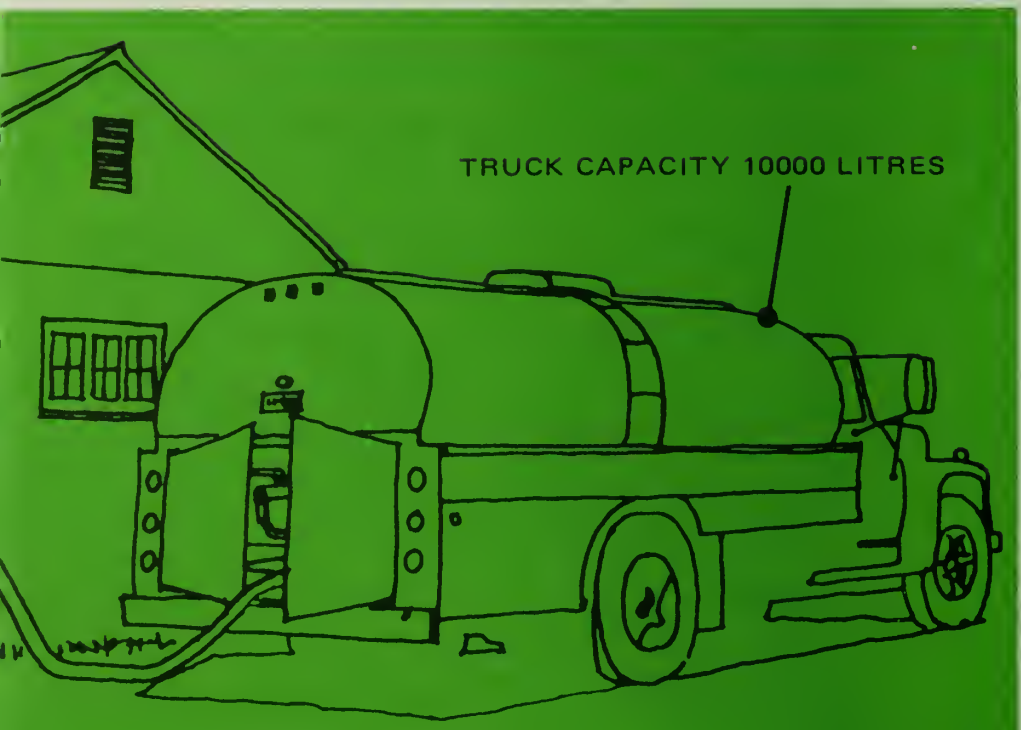
1 fluid ounce = 28 millimeters

TEMPERATURE

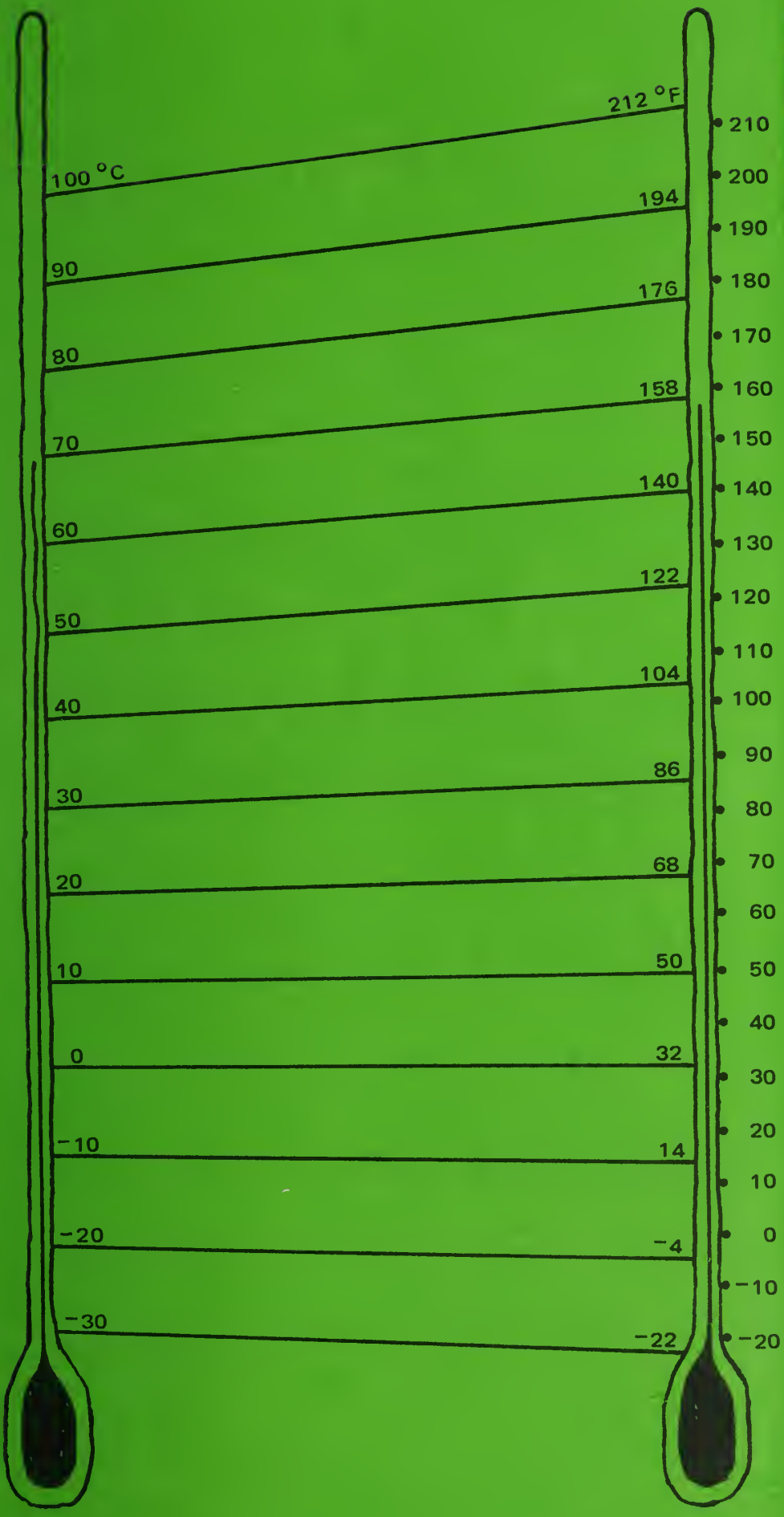
The metric scale for temperature is the Celsius system, known to us mainly through the Centigrade thermometer. On a Celsius thermometer, there are 100 divisions (degrees) between the freezing and boiling points of water.

With a Fahrenheit thermometer, water freezes at 32°F and boils at 212°F, but with a Celsius thermometer it freezes at 0°C and boils at 100°C. For temperatures below zero degrees Celsius, we say −1, −2 (minus one, minus two) degrees.

For further clarification, refer to the graph you will find on the last page; cut it out and stick on your present thermometer to convert it to the Celsius scale (°C). To do this, mark off the distance between the 32 and the 212 of your Fahrenheit thermometer on a strip of paper and then place it next to the dark lines of the diagram so that the 0°C is opposite one of the two marks. Then slip it along, keeping the first mark on zero, until the second mark reaches 100°C. With a pencil, draw a line down the strip and then cut it out to place the markings along the thermometer. The conversion of the thermometer is now complete.



LER CAPACITY 1000 LITRES
TURE 4°C


212 °F
100 °C
194
90
176
80
158
70
140
60
122
50
104
40
86
30
68
20
50
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32
0
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120
110
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80
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−10
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